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**COUNTDOWN ACID RAIN
GOVERNMENT REVIEW OF
THE 16TH PROGRESS REPORTS
(JANUARY 31, 1994)
BY ONTARIO'S FOUR MAJOR SOURCES
OF SULPHUR DIOXIDE**

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EXECUTIVE SUMMARY

This is the review of the four Countdown companies' 16th semi-annual progress reports, which are required to be submitted under Ontario's acid rain regulations. Each of the four sources has met the legal limits for sulphur dioxide (SO₂) and acid gases(SO₂ plus nitric oxide (NO)) to date and are in the process of fine tuning their recently implemented abatement programs to meet 1994 SO₂ emission targets. Reports were submitted to the Minister of Environment and Energy prior to January 31, 1994 and cover the period July 1 to December 31, 1993.

INCO LIMITED

In 1993, Inco estimated its SO₂ emissions to be 357 kilotonnes (kt) (unaudited). The construction part of the smelter abatement program was completed in August, 1993 and bulk concentrate smelting commenced in November, 1993. Since switching to this new technology both the mills rationalization program completed in 1991 and new flash smelting furnaces along with the MK reactor, are currently operating at their design rate. Inco did not face significant technical problems during commissioning of the second oxygen flash furnace and switching to bulk concentrate smelting. The company produced 361 kt of sulphuric acid and 76.2 kt of liquid SO₂ from SO₂ captured from off-gases generated by the new smelting technologies. The report also indicates that based on December 1993 operating rates of bulk concentrate smelting, Inco's 1994 SO₂ emissions should be within the regulation limit of 265 kt.

FALCONBRIDGE LIMITED

In 1993, the company estimated its SO₂ emissions to be 57.3 kt (unaudited). The company reaffirmed its current operational capability to meet the 1994 annual SO₂ emissions target of 100 kt at the smelter rated capacity. In 1993, most modifications were completed on both fluid bed roasters to permit higher sulphur removal rates from the concentrate. During 1993, the fluid bed roasters removed on average 62.3% of the sulphur entering the smelter and 250 kt of by-product sulphuric acid of commercial grade was produced in the acid plant from capturing SO₂ in roaster off-gases. The company is planning to rebuild and improve its No. 2 electric furnace, so that this new single electric furnace will handle all the calcine produced by both roasters. The report indicates that this will improve smelter operation and further lower SO₂ emissions from this facility. The company estimates that the cost of this project is about \$12.0 million. The company has so far invested \$37.0 million for process modifications, capital projects and R & D programs. These changes coupled with the

proposed research program should enable Falconbridge to meet its voluntary SO₂ emissions target of 75 kt at the smelter rated capacity before 1998.

ALGOMA STEEL INC./ ALGOMA ORE DIVISION:

Algoma's SO₂ emissions from its sinter plant at Wawa for 1993 were reported to be 53.8 kt (unaudited) and annual SO₂ emissions for 1994 are expected to be about 61.0 kt. The report indicates that the company plans to produce 1.04 million tonnes of sinter by using iron ore mined at Wawa and increased amounts of low sulphur iron oxides, mill scales, and other iron/steel industry by-products as sinter plant feed in 1994 at this facility. The company is preparing a study report on the viability of Algoma's sintering plant operation at Wawa.

ONTARIO HYDRO

Ontario Hydro's unaudited SO₂ and acid gas emissions for 1993 were estimated to be 95.5 kt and 132.0 kt respectively. Both SO₂ and acid gas emissions were lower by 39% and 37% respectively than in 1992. Fossil fuelled electricity generation was also 36% lower during this period as compared to 1992. In 1993, Hydro spent \$247.0 million on measures contributing to acid gas control. About 92% of this acid gas control expenditure was for premiums on low sulphur coal purchases and the Lambton flue gas desulphurization (FGD) project. The Lambton FGD program is within budget and on schedule and commissioning is planned for the summer 1994. The flue gas conditioning (FGC) systems at all stations have been operating at the boiler design capacities without environmental problems and opacity exceedences. Hydro plans to install combustion process modifications (CPMs) at Lambton Unit #4 before the end of 1994. When completed, CPMs at Lambton, along with other NO_x control measures, would enable Hydro to meet its voluntary annual target of 38 kt of nitric oxide (NO) per year by 2000. Hydro has installed flue gas emission monitors (FGMs) at all operating coal and oil fired boilers. These FGM systems are presently being verified for accuracy and reliability.

INTRODUCTION

Four major corporate sources (Inco, Falconbridge, Algoma at Wawa, and Ontario Hydro) produce about 80% of Ontario's sulphur dioxide (SO₂) emissions. Each source is required by Ontario's **Countdown Acid Rain** regulations to report every six months on the progress made to reduce SO₂ emissions.

The Countdown program was formulated in 1985 and requires an annual SO₂ emissions cap of 885 kt on all sources in the province, to be in place by 1994. Specific reductions for the four companies began in 1986 and will culminate in a cap totalling 665 kt of SO₂ by 1994. In the case of Ontario Hydro, limits were also placed on the combined emissions of SO₂ and nitric oxide (NO) and an interim cut of 35%, limiting SO₂ to 240 kt and acid gases (SO₂ + NO) to 280 kt, was also imposed for 1990-1993. The Countdown limits are in addition to standards imposed to ensure good ambient air quality. Annual legal limits for SO₂ are summarized in Table 1.

Table 1
Sulphur Dioxide Legal Limits
(kilotonnes per year)

	<u>1985</u>	<u>1986</u>	<u>1990</u>	<u>1994</u>
Inco nickel/copper smelter, Sudbury	728	685	685	265
Falconbridge nickel/copper smelter, Sudbury	154	154	154	100
Algoma iron ore sintering plant, Wawa	285	180	180	125
Ontario Hydro fossil fuel power plants, province-wide	390	370	240	175
Legal Limits Sub-total:	1,557	1,389	1,259	665

Each of the four sources has met the legal limits to date and each has submitted detailed plans for implementing its reduction program, as required by the regulations. The sixth set of company progress reports, received in December 1988 (metallurgical companies) and January 1989 (Ontario Hydro), set out the detailed methods and schedules for meeting the emission limits of the Countdown regulations. They were accepted by the government.

Implementation progress reports are required every six months. This document summarizes the contents of the 16th set of semi-annual company reports and the government response. Previous semi-annual reports are available from the Public Affairs and Communications Services Branch, Ontario Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, Ontario, M4V 1P5, (416) 323-4321.

COMPANY REPORTS AND GOVERNMENT RESPONSES

The progress reports were reviewed by the Countdown Technical Support Group (CTSG) drawn from the Ontario Ministries of Environment and Energy and Northern Development and Mines (for the metallurgical companies).

The implementation phase of the Countdown program is progressing very well. A summary of the individual reports and Ontario government's response follows.

INCO LIMITED

Regulation 660/85 requires a reduction in annual SO₂ emissions from Inco's nickel/copper smelter complex in Sudbury so that emissions will not exceed 265 kt for any year after 1993, compared to the current limit of 685 kt per year. The company was also required to examine the feasibility of going beyond the limit of 265 kt by 1994 specifically to a level of 175 kt at some future date. Consequently, the feasibility of continuing technical advances remains a concern of Inco and of the government. The government previously accepted Inco's position that a specific interim reduction prior to 1994 was not feasible because of the nature of the major process changes being undertaken to meet the 1994 sulphur dioxide emission limit.

Company Report

The company's 16th progress report covering the period July to December 1993 presents the following points:

- The construction of the SO₂ Abatement Program (SO₂AP) was essentially completed in August 1993, 54 months after starting in February 1989.
- The smelter SO₂AP was completed on schedule and within budget of \$540 million. The total SO₂ Abatement Program costs including the Mills Rationalization Program were about \$612 million.
- The smelter SO₂AP required some 415,000 man-days of engineering and construction effort. A total of 221 separate construction contracts were awarded and 179 of these went to Northern Ontario Companies.
- Bulk smelting of nickel copper concentrate commenced on November 1, 1993 and the report indicates that there were no major problems during commissioning.
- Based on the December 1993 operation of this technology the company is confident that the smelter 1994 SO₂ emissions are likely to be lower than the 265 kt limit for 1994.

- The report indicates that in 1993 Inco produced a total of 361 kt of sulphuric acid and 76.2 kt of liquid SO₂ by-products from SO₂ captured from smelting process off-gases.

Phase II: SO₂ Abatement Program

- Phase II construction work covering the second (i.e. # 1) nickel flash furnace and ancillary equipment was completed in July 1993.

SECOND FLASH FURNACE START-UP (NO. 1 FURNACE)

- After a thorough checkout during the July 1993 shutdown, the heat up was started with an initial 7 day soak at 510° C followed by daily increase of temperature by 130° C. Roof adjustments were made when the furnace temperature approached 1200° C and furnace feed commenced on August 17, 1993. The commissioning of No. 1 flash furnace (2nd Flash Furnace) did not pose any major technical difficulties.
- Earlier problems of improper arching with the No. 2 flash furnace roof were solved in the summer by using a hanging brick design; the roof now appears to be in satisfactory condition. The company continues to make minor changes to both these furnaces in order to optimize throughput rates and on-line availability.
- The report also indicates that Inco plans to remove some trays in the froth columns of the gas cleaning circuits of both furnaces during the January and February 1994 shutdown. At present, this seems to be creating a bottleneck for higher smelting rates due to increased pressure drop.

ACID PLANT

- The report indicates that NO_x contamination of the sulphuric acid product was solved by installing low NO_x burners on the MK reactor which reduced NO_x levels in the reactor off-gases by 66 % and a new NO_x stripper was added to the acid plant to treat 2 tonnes per day nitro-sulphuric acid bleed from the demisters. After completion of these changes the product acid NO_x levels have dropped sufficiently to be within the specifications.

Government Review

The government review concluded that Inco continues to meet the requirements of Regulation 660/85.

The CTSG review team is also pleased to note that the company has successfully completed SO₂AP project on time and without any outside financial assistance.

SO₂ Emissions

- SO₂ emissions for 1993 were estimated by Inco to be 357 kt (unaudited). This is 15% less than 1992 SO₂ emissions and 48% below the legal limit for 1993.
- Lower SO₂ emissions are expected in 1994 with full commissioning and optimization of the bulk smelting process.

SO₂ Fixation:

The newly built double contact acid plant and associated gas cleaning system operated without serious technical problems. In 1993, the acid plant and the liquid SO₂ plant captured about 312 kt of SO₂ from the new flash furnace and MK reactor off-gases. Inco's new acid plant technology is an integral part of the bulk smelting technology such that if either of the systems face operating problems the entire system would have to be shut down. This will provide protection to the environment from elevated SO₂ emissions due to possible upsets from the nickel and copper concentrate smelting operations.

General Comments

- The Ministry noted that overall Inco's 16th semi-annual progress report was brief and did not provide sufficient details in many areas. The CTSG is expecting to discuss those areas of interest with Inco representatives in a meeting and tour of facilities in fall 1994.
- As required by Regulation 660/85 Inco is to investigate the possibility of reducing annual SO₂ emissions to 175 kt from its Sudbury smelting operations. The status of the company's progress in meeting this lower limit is required.
- Although Inco's covering letter indicates this report as the final program report, the company is reminded that the Countdown Program is deemed to be completed at the end of 1994, i.e. with the first year compliance of the new SO₂ emission limit.

FALCONBRIDGE LIMITED

Regulation 661/85 requires Falconbridge to reduce its annual SO₂ emissions from its Sudbury nickel-copper smelter complex so as not to exceed 100 kt after 1993. The regulation also requires Falconbridge to evaluate the possibility of further reducing SO₂ emissions. Promising areas for further reductions have been identified by the company.

Company Report

The 16th semi-annual progress report, covering the period July to December 1993, presents the following points:

- The company reaffirms its earlier commitment to meet the 1994 annual SO₂ emission limit of 100 kt at a rated capacity of 88 million pounds of nickel as concentrate. This emission reduction achievement was the result of technical and operational developments by the company such as improved pyrrhotite rejection, increased degree of roasting and sulphuric acid production, enhanced slag cleaning operation, separate copper concentrate production, and increased smelting of recycled materials. The company claimed to have achieved the operational capability of meeting its 100 kt SO₂ emissions annual limit 3 years earlier than required by Regulation 661/85.
- Falconbridge will continue to invest capital in the Strathcona Mill and smelter, and conduct research and development in promising areas. This investment will enable the company to meet its voluntary SO₂ emission target of 75 kt at the smelter rated capacity before 1998.
- In 1993, the company estimated its sulphur dioxide emissions to be 57.3 kt (unaudited).
- The fluid bed roasters removed on average 62.3% of the sulphur entering the smelter in 1993. Also 96% of this sulphur (as SO₂) was captured in the single contact acid plant converting it to commercial grade sulphuric acid. In 1993, 81.6 kt of sulphur was converted to sulphuric acid.
- The report also indicates that the company has spent in excess of \$37 million for capital for process modifications, capital projects and research and development in support of the company's SO₂ abatement program between 1989-1993.
- The report further notes that the company's commitment to lower annual SO₂ emissions to 75 kt/year by 1998 appears to be on track in spite of softer nickel markets.
- Except for some changes in the acid plant and installation of large flotation cells (Phase IV) at Strathcona Mill, all other planned modification projects are expected to be in service before the end of 1993 as per current schedule.
- Falconbridge has again repeated its earlier request for a more flexible certificate of approval amendment process for completing the necessary process changes in order to meet the voluntary SO₂ emissions target of 75 kt by 1998.
- Smelter/Roaster design and operating changes
 - # 2 roaster hearth size was increased from 5.6 m to 6.1 m during the July 1993 shutdown and modifications were made to tuyeres to increase fluidizing air capacity. These new tuyeres are made of material suitable to withstand high roasting temperatures expected with increased sulphur removal.

- New flues were installed in the by-pass secondary cyclones to reduce pressure drop and provide increased gas handling capacity. Plans are also being firmed up for mechanical upgrades to No. 2 Roaster fan and electrostatic precipitator (ESPs).

- **Single Furnace Project:**

- To improve smelter operation with higher degrees of roast (i. e. calcine with lower sulphur content) and further lower SO₂ emissions, process equipment modifications would be made to i) furnace crucible, ii) off-gas system, iii) feed system, iv) furnace power system and v) slag disposal system. The estimated cost of these changes is about \$12.5 million and significant design work has been already completed in the latter part of 1993; the project is to be completed by the end of 1994. When in operation this furnace is expected to handle the total calcine from both roasters and need about 47 MW of electric power to operate. The existing No. 2 electric furnace will be modified to meet the new single furnace criteria.
- Additional modifications to selected pieces of equipment in the roasters, the acid plant and smelter areas are planned for implementation after 1993 to improve smelter performance and to reduce SO₂ emissions.

- **Acid Plant**

- The report indicates that more upgrading may be required to handle future higher roaster off-gas flowrates and increased acid production in the following areas: (a) converter catalyst; (b) weak acid cooling (Phase 4) and (c) drying and absorbing tower demisters.

- **Strathcona Mill Modifications**

- The mill process control is now carried out by the new Foxboro distributed control system (DCS). The connection of primary grinding circuit to DCS is planned for April 1994.
- Commissioning of the first Outokumpu courier on-stream analyzer was completed. Plans are also being made to commission the second installed analyzer on remaining feed streams in 1994.
- Construction of Phase III to install larger flotation cells of 1340 cu.ft. to improve scavenger material flotation will be carried out in 1994. The total cost is estimated to be \$3.0 million. Once completed it would provide the needed space for installation of new cleaning cells for pyrrhotite rejection circuit.

- **R and D Program**

1. Smelter: Two trial campaigns were completed using the prototype matte tap hole in 1993 to achieve 18% metallization under stable operating conditions. The company continues to sponsor research at Universities of McMaster and Toronto on nickel smelting mechanisms and heat/mass transfer in the smelting furnace.
2. Strathcona Mill: The pyrrhotite rejection plant was operated for 6 months in 1993 on a variety of feeds. Cleaning in column or Jameson cells gave high grade nickel concentrate with excellent recovery. Funds are requested from management for applying these findings to pyrrhotite rejection circuit modifications.
 - About \$450,000 were spent in the 2nd half of 1993 for developmental work in i) flow-sheet development, ii) plant scale tests, iii) primary grinding improvement, iv) regrinding, v) magnetic separation and vi) mineral flotation circuit to improve nickel concentrated grade and provide higher degree of pyrrhotite rejection.

Government Review

The Countdown Technical Support Group (CTSG) concluded that the company's 16th semi-annual progress report met the requirements of Ontario Regulation 661/85. The CTSG is satisfied with the technical progress Falconbridge has achieved in meeting its SO₂ emissions limit of 100 kt at design smelter production capacity three years ahead of schedule. The CTSG is further encouraged to note that continuing investments in R & D and capital projects will likely enable Falconbridge to achieve its SO₂ emissions goal of 75 kt/yr at the smelter design capacity earlier than 1998.

Additional CTSG comments are as follows:

- The CTSG is generally satisfied with the company's efforts to improve nickel concentrate grade from 6.8 to 9.0% over the period 1990 to 1993 without increased nickel losses in the pyrrhotite discard portion.
- The company continues to provide updated flowsheets on various process changes; these and the sulphur balance information are helpful in understanding the reported changes and in following the progress of the company's SO₂ Abatement Program.
- The CTSG wants clarification on the current practice of handling of up to 180 tonnes/day of copper concentrate separated at Strathcona Mill and the fate of remaining SO₂ emissions of about 40 kt/yr associated with this material.

- The CTSG wishes to discuss with the company its latest plans to use a single electric furnace at a cost of \$12 million in the meeting planned for fall 1994. As this was not part of Falconbridge's SO₂ abatement program (Final SO₂ Abatement Program Report, December 1988), the Ministry wants to be fully appraised of this new technical development.
- The company's request for a more flexible certificate of Approval (C of A) amendment process for making smelter process changes to reach its 75 kt SO₂ emissions target will be carefully reviewed by the appropriate Ministry staff and the decision will be communicated to the company by Mid Ontario Region (MOR).
- This report has raised several issues, which are of concern to the Ministry. These and other issues related to Falconbridge's smelting operations will be discussed with the company in a meeting and plant tour planned for 1994.

ALGOMA STEEL INC.

The Algoma Steel Inc. (Ore Div.) operates an iron ore sinter plant at Wawa, about 270 km northwest of Sault Ste. Marie. Regulation 663/85 limits current SO₂ emissions from the operation to 180 kt per year, dropping to no more than 125 kt per year effective 1994.

In August of 1986, the sinter production capacity at Wawa was permanently down-sized by about 50 per cent. The lower production rate when combined with reduced sulphur levels in the feed has resulted in substantially reduced SO₂ emissions.

Company Report

The company's 16th semi-annual progress report covering the period January to June 1993 confirms that the company will meet the 1994 SO₂ emission limit by the reduction of sinter capacity. In addition, continued and possibly increased use of low sulphur iron oxides at Wawa plant could further reduce current levels of SO₂ discharged from the sinter plant stack.

The 16th semi-annual progress report also presents the following information:

- In 1993, the Algoma's Ore Division reported its SO₂ emissions were estimated to be 53.8 kt. (unaudited). The sinter production was 1.15 million tonnes.
- The company forecasts 1994 SO₂ emissions to be about 61.0 kt at a sinter production rate of 1.04 million tonnes.
- The company plan indicates that use of low sulphur iron oxides and mill scale in sinter plant feed will be continued and should help to maintain current and projected annual SO₂ emissions to about 60 kt or less, which is well below the 1994 limit of 125 kt.

Government Review

- The CTSG concluded that the company continues to meet the requirements of Regulation 663/85.
- No changes have been reported in the company's plans to meet the 1994 annual SO₂ emission target of 125 kt but the CTSG notes that average sulphur content of sintering plant feed is expected to go up by 7.2% from the current level of 1.52% (w\w) due to changes in blended feed composition and increased use of coke and fuel oil.
- The company has provided SO₂ emission estimates for the appropriate review period and included general information on production activity at its Wawa sinter plant as requested earlier.
- The CTSG has learned that Algoma is preparing a study report on the viability of the Wawa sinter plant operation.

ONTARIO HYDRO

Regulation 355, R.R.O. 1990 (formerly O.Reg. 281/87) requires Ontario Hydro to meet interim annual emission limits for 1990-93 period and imposes a tighter limit for 1994 and beyond. Separate limits are set for SO₂ alone and for the sum of SO₂ plus NO (nitric oxide), as shown in Table 2.

Table 2
Ontario Hydro's Sulphur Dioxide and
Acid Gas Emissions Limits

<u>Period</u>	<u>Regulated Limits</u>	
	<u>SO₂</u> (kilotonnes per year)	<u>SO₂ + NO</u>
1986 to 1989	370	430
1990 to 1993	240	280
1994 and future	175	215

Company Report

The corporation reports that in 1993 unaudited acid gas emissions were estimated at 95.5 kt of SO₂ and 132.0 kt of acid gases (SO₂ plus NO) respectively. The reported SO₂ and acid gas emissions were lower by 39% and 37% respectively than in 1992. Fossil-fuelled electricity generation was also 36% lower during this year as compared to 1992.

Acid Gas Control Costs:

The corporation reports that expenditures of \$247.0 million were incurred for the period January to December 1993 on measures contributing to the reduction of acid gas emissions, as follows:

- \$124.0 million was spent for flue gas desulphurization (two FGD scrubbers) for the Lambton Thermal Generating Station (TGS).
- \$730,000 expense was incurred for flue gas conditioning at the Lambton, Nanticoke, and Lakeview stations. This measure allows Hydro to burn lower sulphur coal at these locations until suitable control measures are installed.
- \$11.30 million was spent for combustion process modifications (CPMs).
- \$103.6 million was spent on low sulphur coal premiums, which was partly for acid gas control. This is approximately 42 % of the total expenditure reported by Hydro for acid gas control in this report.
- \$5.7 million was allocated for compliance with the emissions verification and reporting order issued by the Ministry in June 1990.
- \$1.4 million was allocated for research and development.
- The total cost of FGD scrubber project at Lambton is estimated at about \$537.5 million. The construction of the two FGD scrubbers is nearing completion and one of the two units is expected to be in-service in summer 1994.

Acid Gas Control Programs:

- The 16th semi-annual progress report also indicates that the flue gas conditioning (FGC) equipment with sulphur trioxide (SO₃) and ammonia (NH₃) conditioning agents has been working well for all units at Lambton and Nanticoke without opacity problems and at boiler capacity ratings when using lower sulphur coals.

- Lakeview units 1 and 2 are equipped with new high performance electrostatic precipitators (ESPs) and are expected to operate satisfactorily without FGC at the boiler design rate. Units 5 and 6 at Lakeview have been modified and can operate satisfactorily with only SO₃ conditioning of flue gases. Other Lakeview units 3, 4, 7 and 8 have been removed from service in early 1993.
- The Corporation is assessing the technical feasibility of implementing nitric oxide (NO) emission controls on existing fossil fuel stations. Combustion process modifications (CPMs) for unit #4 at Lambton should be in operation by the end of 1994. Hydro is having discussion with some U.S. utilities to evaluate urea injection and has signed an agreement with Southern Company Services for selective catalytic reduction (SCR) technologies testing program for North American coals.

Emissions Monitoring:

- The report also indicates that Hydro has installed flue gas monitoring devices (FGMs) on most fossil-fuel boilers in order to meet the Ministry's acid gas (SO₂ and NO) emissions verification and reporting order requirements. Many systems have already completed Relative Accuracy Test Audit (RATA) tests and others are currently in the process of undergoing verification tests. Hydro has started a 6 month comparison study for a typical unit at the Nanticoke TGS to demonstrate the accuracy of SO₂ and NO emission measurements of the FGM systems and in-stack continuous emission rate monitoring (CERM) unit in October, 1993.
- NO vs. Load Curves: The report indicates that Hydro plans to develop these curves with FGM systems after completing verification tests at each unit.

Government Review

Some points noted by the reviewers are listed below:

- The CTSG concluded that Ontario Hydro's 16th semi-annual progress report meets the requirements of Regulation 355 R.R.O. 1990 (formerly O. Reg.281/87).
- The CTSG further noted that more than 92% of the expenditures reported for acid gas control measures in 1993 was for the premium on low sulphur coal purchases and the Lambton FGD project.
- The CTSG is pleased to note that Lambton FGD project is on schedule and within budget.

- Ontario Hydro is waiting for Ministry's approval under the emissions verification and reporting Order on FGM systems at various operating units in order to update NO vs. load curves for these units. To date the Ministry has witnessed several FGMs verification tests and most have received passing grades. However, final Ministry approval can be given only when the final Relative Accuracy Test Audit (RATA) reports have been received and reviewed by the Ministry staff. In the meantime, Hydro could proceed with development of NO vs. load curves for units with acceptable FGM verification test results.
- Premiums for lower sulphur coal fuel in 1993 were 29.7% lower than 1992. These costs should drop further as Lambton's two FGD scrubber units using 2.5% sulphur coal fuel were put into service and operated at higher capacity factors.

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